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(54) Wound dressing.

(57) There is disclosed a wound dressing comprised by an assembly of microfungal fibres which have been treated with alkali to expose chitin and chitosan, frozen and freeze dried. The fibres may be derived from vegetative hyphae or from sporangiophores. The assembly may include other fibres, may be bleached and incorporate other additives such as silver as an anti-bacterial agent.

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This invention concerns wound dressings.

The wound healing properties of chitin and chitin derivatives have long been recognised and documented. The extraction of chitin from its natural sources and its incorporation in conventional wound dressings, however, is quite costly.

The present invention provides an improved wound dressing at economic cost.

The invention comprises a wound dressing comprised by a wet-laid mat of microfungal fibres which have been treated with alkali to expose chitin and chitosan, characterised in that the assembly is frozen and freeze-dried.

The microfungal hyphae may be vegetative hyphae or sporangiophores and may for example be Mucor mucedo or Rhizomucor miehei.

The assembly may be a wet-laid mat, which may include a plasticiser which may be glycerol or polyethylene glycol, for example.

The assembly may be cut to a desired size and sealed in a water vapour impermeable pack.

The microfungal fibres may be bleached. The assembly may include other fibres of substances known to assist or facilitate wound healing, such as collagen, a well-known haemostatic agent or an alginate, useful as a physical barrier to prevent drying and adhesion between the wound and the dressing material. The wet-laid mat may also incorporate bound metallic silver, useful as an antibacterial agent.

The assembly may be treated with a bi-functional cross-linking agent such as glutaraldehyde.

The invention will be further apparent from the following description which concerns by way of example only the preparation of various forms of wound dressing embodying same and with reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic illustration of a batch process for preparing a first form of wound dressing;

Figure 2 is a diagrammatic illustration of a batch process for making a second form of wound dressing; and

Figure 3 is a diagrammatic illustration of a continuous process for making the second form of wound dressing.

Referring firstly to Figure 1, micro-fungal mycelia are produced from a culture of Mucor mucedo (CMI 184 726), grown in a nutrient solution containing malt extract (17g/1) and mycological peptone (3g/1) in a fermenter vessel 10 at a temperature of 30°C for one to two days.

The culture is then washed and treated with a 2N boiling solution of sodium hydroxide for one hour to dissolve protein from the outer layers of the cell walls and expose the underlying chitin and chitosan. Further de-acetylisation of the chitin may be effected by 40% sodium hydroxide solution.

The culture is repeatedly washed until neutral pH is obtained and then bleached by treatment with a solution of hydrogen peroxide (80 ml/l 37% H_2O_2 + 40 g/l NaOH + 40 g/l sodium silicate) for two hours at room temperature.

The culture is washed again and disintegrated using normal paper making equipment 11 to ensure an even dispersion of the fibres in water to form a slurry. The slurry is strained through a filter medium 12 to leave a wet-laid matt 13 having a thickness of 1mm or thereabouts.

If desired other fibres having wound healing properties such as of collagen or an alginate or both may be mixed with the fibres before the matt is laid, as may textile fibres to give mechanical strength or other properties.

Suitably sized portions 14 for wound dressings of desired size are cut from the matt 13 and, according to parent European Application No.87304365.7 (0,291,587), from which this application is divided, immediately encapsulated whilst still wet in airtight packs 15 and subsequently sterilised. The retained water acts as a plasticiser to prevent the fibres from becoming dry and brittle and also ensures that the dressings are moist when removed from the packs for use.

Alternatively glycerol or polyethylene glycol may be added to the slurry before the matt is laid.

In another example Mucor mucedo is replaced by Rhizomucor miehei (CMI 147 066) which is fermented at 50°C.

In yet another example sporangiophores of Phycomyces blakesleeanus (CBS 283 35) are grown in static culture, harvested and introduced to the vessel 10 for the alkali and subsequent treatments.

As shown in Figure 2, however, and according to the present invention, the slurry from vessel 10 is poured in to shaped moulds or dishes 20 which are then frozen in a deep freezer 21 for, say, sixteen hours and then freeze-dried for twenty eight hours in a freeze-drier 22. Absorbent pads typically of say 10cms in diameter or larger and from a few millimetres to several centimetres thick can be produced in this way.

Figure 3 illustrates d continuous process for producing a web, in which the slurry is laid down using conventional paper making machinery 30 and passed straight into a continuous freezer 31 and from there into a continuous freeze drying plant 32 after which the resulting matt 33 can be rolled up as at 34.

It is surprising that the matt is so flexible and strong as to permit this since, previously, 100% fungal matts have been brittle unless plasticiser has been added.

Use of a placticiser in freeze-dried wound dressings is not necessary but a plasticiser may of

course be added if desired.

It will be appreciated that it is not intended to limit the invention to the above example only, many variations, such as might readily occur to one skilled in the art, being possible, without departing from the scope thereof as defined by the appended claims.

Thus for example, the matts or pads or fibres from which they are formed may be treated in a solution of silver nitrate whereby silver ions will be captured by the chitosan and thus be present in the dressings as an anti-bacterial agent.

Again for example, the dressings may be treated with a bi-functional cross-linking agent such as glutaraldehyde.

Yet again, for example the wet-laid matts may be laminated with one or more backing layers of conventional, textile fibre if desired.

Tests carried out by Royal National Orthopaedic Hospital at Stanmore Middlesex, indicated that wound dressings prepared in accordance with the invention from Mucor mucedo gave encouraging results in terms of the quality and quantity of repair tissue.

Claims

1. A wound dressing comprised by an assembly of microfungal fibres which have been treated with alkali to expose chitin and chitosan, characterised in that the assembly is frozen and freeze-dried.

2. A wound dressing according to claim 1, characterised in that the microfungal fibres are hyphae.

3. A wound dressing according to claim 1, characterised in that the microfungal fibres are sporangiophores.

4. A wound dressing according to any one of claims 1 to 3, characterised in that the assembly is a wet-laid mat.

5. A wound dressing according to claim 4, characterised in that the wet-laid mat includes a plasticiser.

6. A wound dressing according to any one of claims 1to 5, characterised in that the assembly is cut to size and sealed in a water vapour impermeable pack.

7. A wound dressing according to any one of claims 1 to 6, characterised in that the microfungal fibres are bleached.

8. A wound dressing according to any preceding claim, characterised in that other fibres are included with the microfungal fibres.

9. A wound dressing according to any preceding claim, characterised in that the alkali treated fibres are treated with a silver salt whereby silver ions are captured and present in the dressing as an anti-bacterial agent.

10. A wound dressing according to any preceding claim, characterised in that the wet-laid mat is treated with a bi-functional cross-linking agent.

11. A wound dressing according to any one of claims 1 to 10, characterised in that the assembly is laminated with one or more backing layers of conventional textile material.

12. A method for making a wound dressing of microfungal fibres which have been treated with alkali to expose chitin and chitosan, characterised by comprising the step of freezing and freeze drying an assembly of the fibres.

13. A method according to claim 12, characterised by forming a wet-laid mat of the fibres and freezing and freeze drying the same.

14. A method according to claim 13, characterised in that a microfungal fibre slurry is poured into shaped moulds or dishes (20), frozen in a freezer and then freeze dried.

15. A method according to claim 13, characterised in that a microfungal fibre slurry is laid down using conventional paper making machinery (30).

16. A method according to claim 15, characterised in that the laid down slurry is frozen in a continuous freezer (31).

17. A method according to claim 16, characterised in that the frozen, laid down slurry is freeze dried in a continuous freeze drying plant.

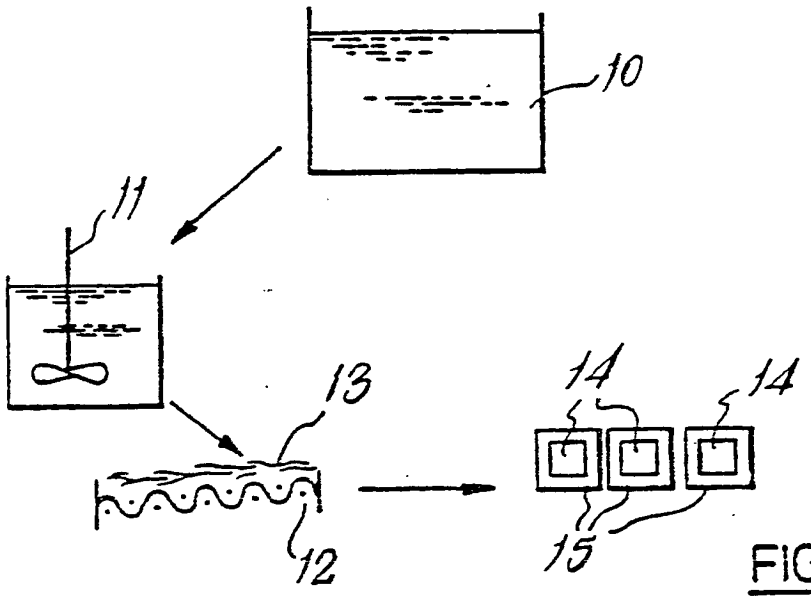


FIG.1

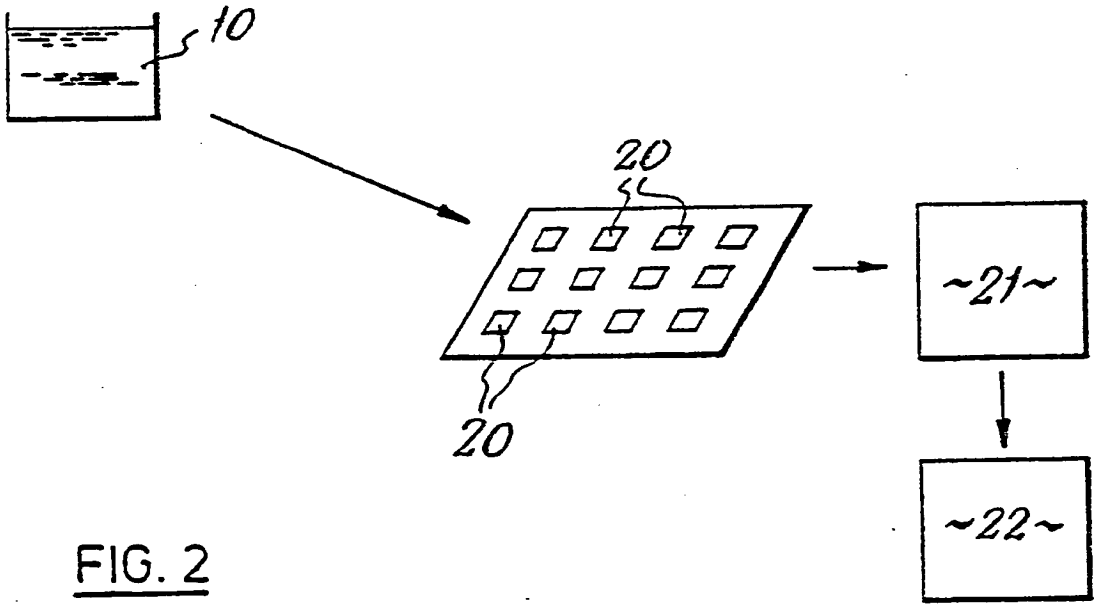
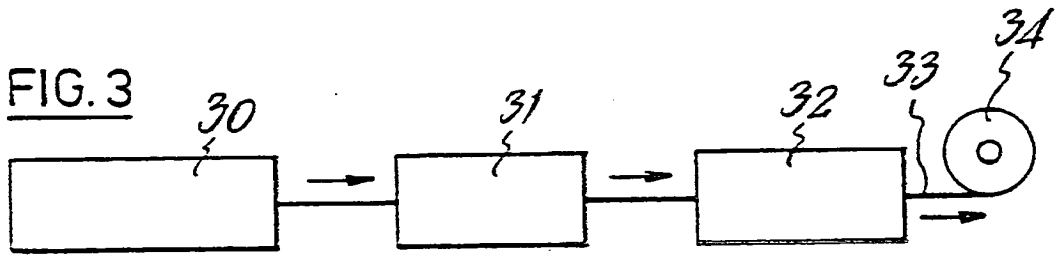


FIG. 2

FIG. 3



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EUROPEAN SEARCH REPORT

Application Number

EP 91 20 1911

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	GB-A-2 148 959 (SHIRLEY INSTITUTE) * Examples I,II; claims 1-18 *	1-5,11	A 61 L 15/28 A 61 L 15/40 A 61 L 15/46

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

A 61 L

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	06 November 91	PELTRE CHR.

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
Y: particularly relevant if combined with another document of the same catagory
A: technological background
O: non-written disclosure
P: Intermediate document
T: theory or principle underlying the invention

E: earlier patent document, but published on, or after the filing date
D: document cited in the application
L: document cited for other reasons

&: member of the same patent family, corresponding document